

## Background

- 10-mile Emergency Planning Zones (EPZs) are required around every NPP.
- Advanced Reactors have design features that allow for scalable EPZ sizes.
- A proposed rulemaking would set EPZ boundaries at the maximum distance where dose remains less than 1 rem (TEDE) over 96 hours.

## Constraints

- SMR source term
- 1 rem at 2-miles
- 96 hour dose projection

## RASCAL Source Term

RASCAL utilizes LWR fuel nuclide inventory for defined accident scenarios. Base case gives 1 rem at 2-miles.

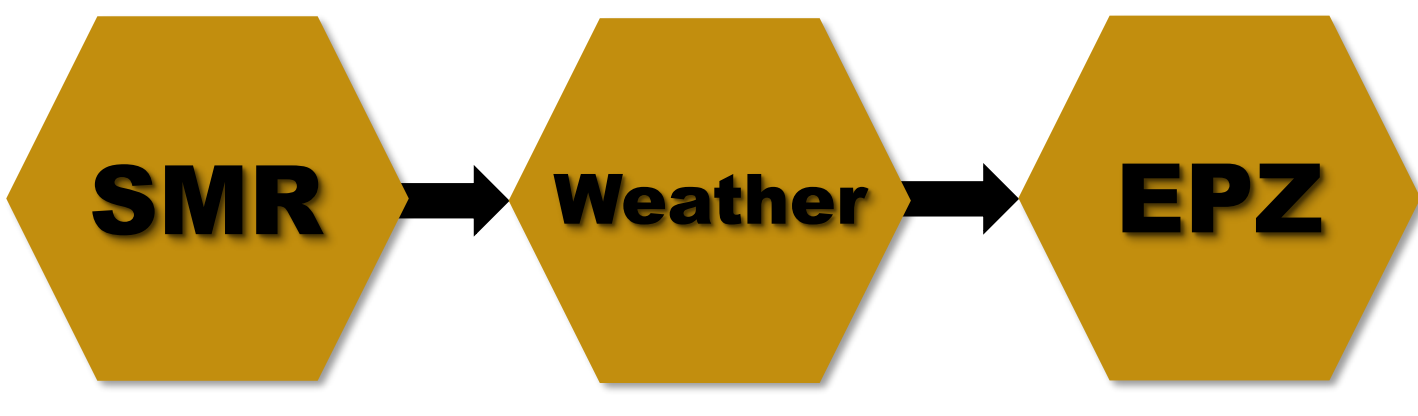
### LOCA

- 36% clad damage
- No containment
- Core uncovers in 1 hour

### LTSBO

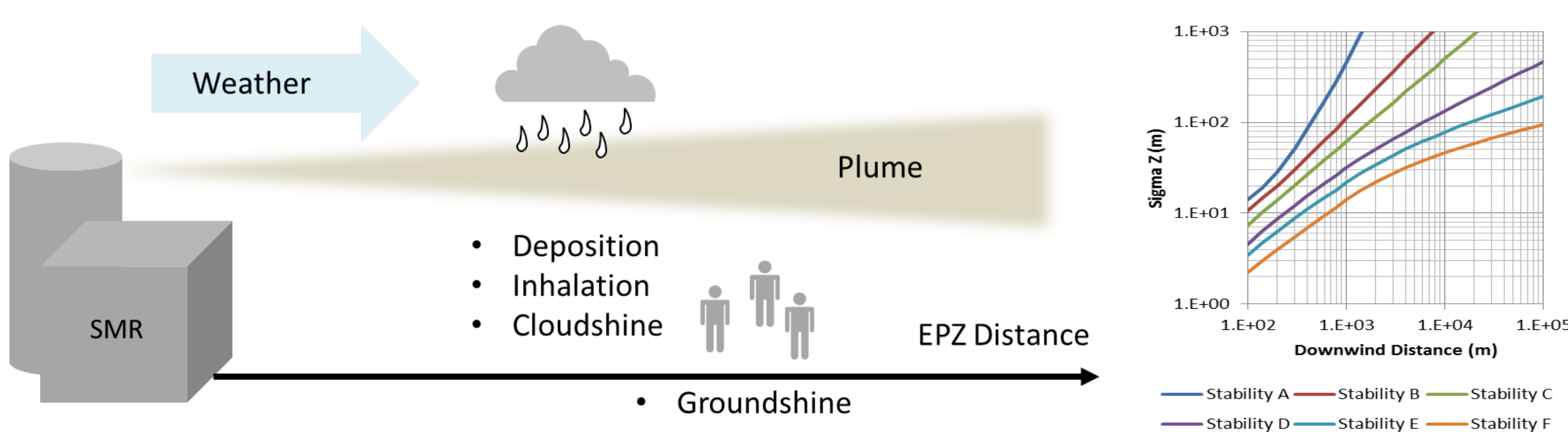
- 1% core melt
- 8%/hr containment leakage
- Core uncovers in 8 hours

## Problem Statement



*How sensitive are dose projections to weather phenomena?  
What is the impact on EPZ size?*

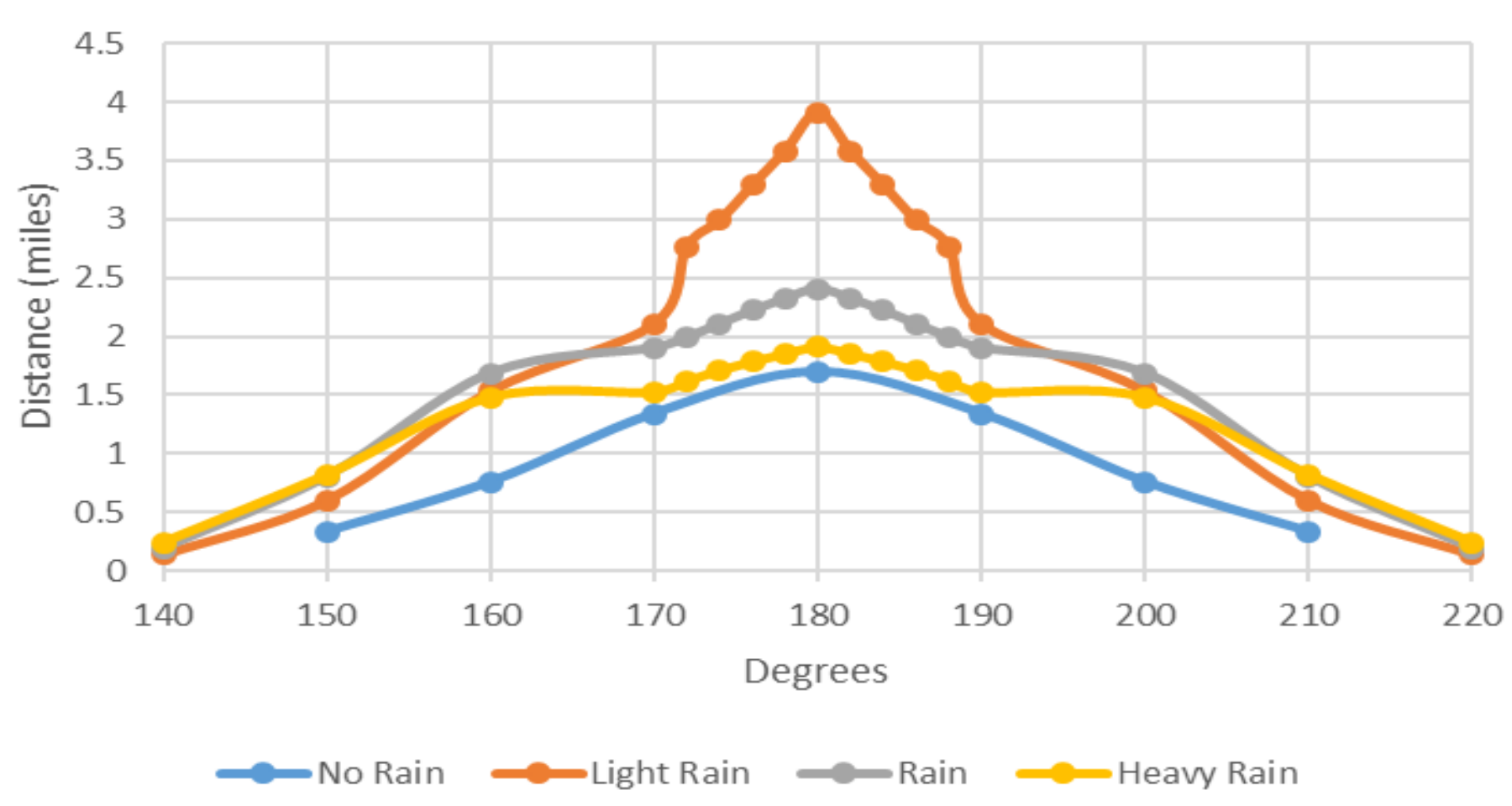
## Using RASCAL for Dose Projections



## Weather Sensitivity Analysis

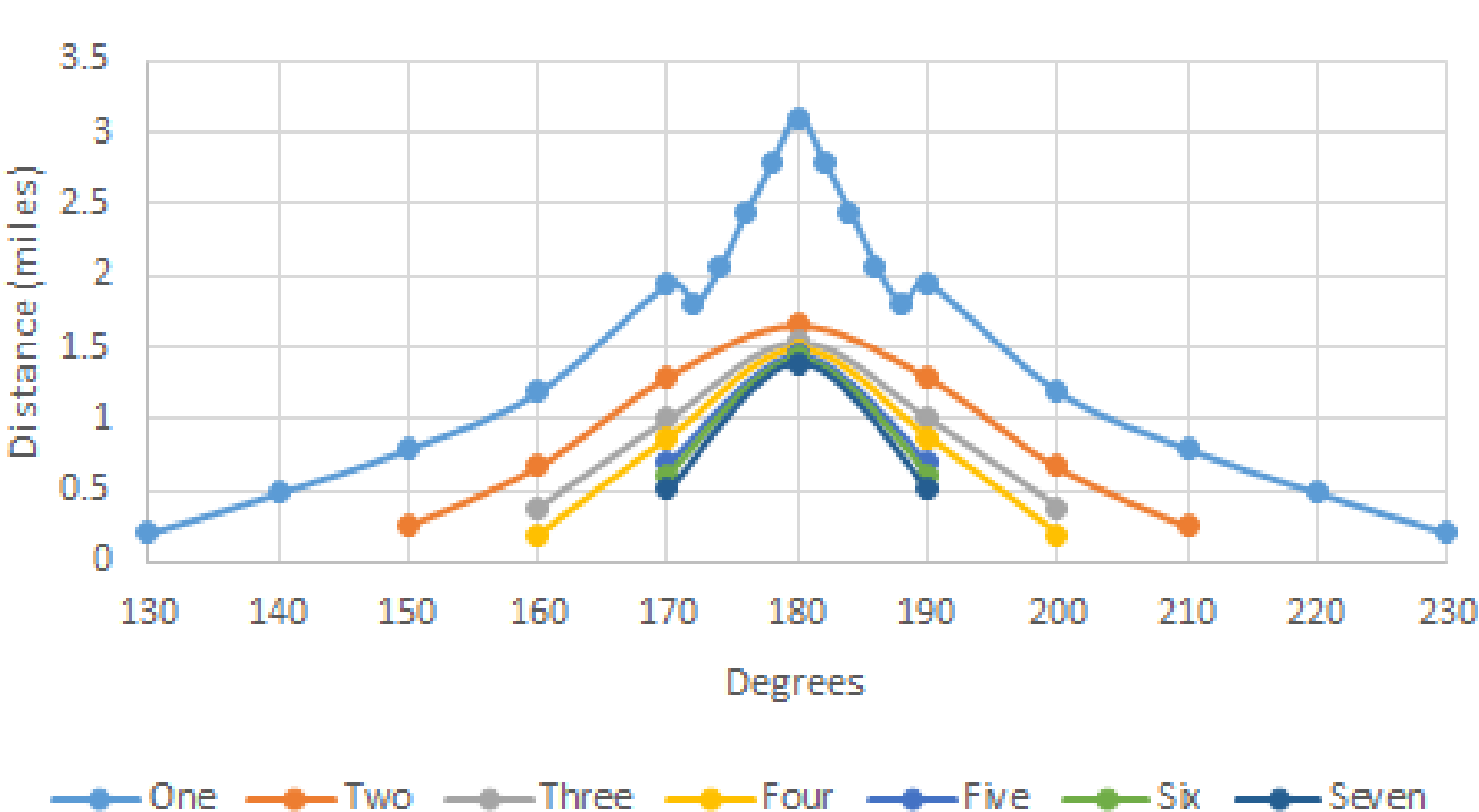
Results displayed for LTSBO as the findings were more pronounced than LOCA.

1 rem Isodose Distance vs. Plume Angle  
Rain Sensitivity Analysis



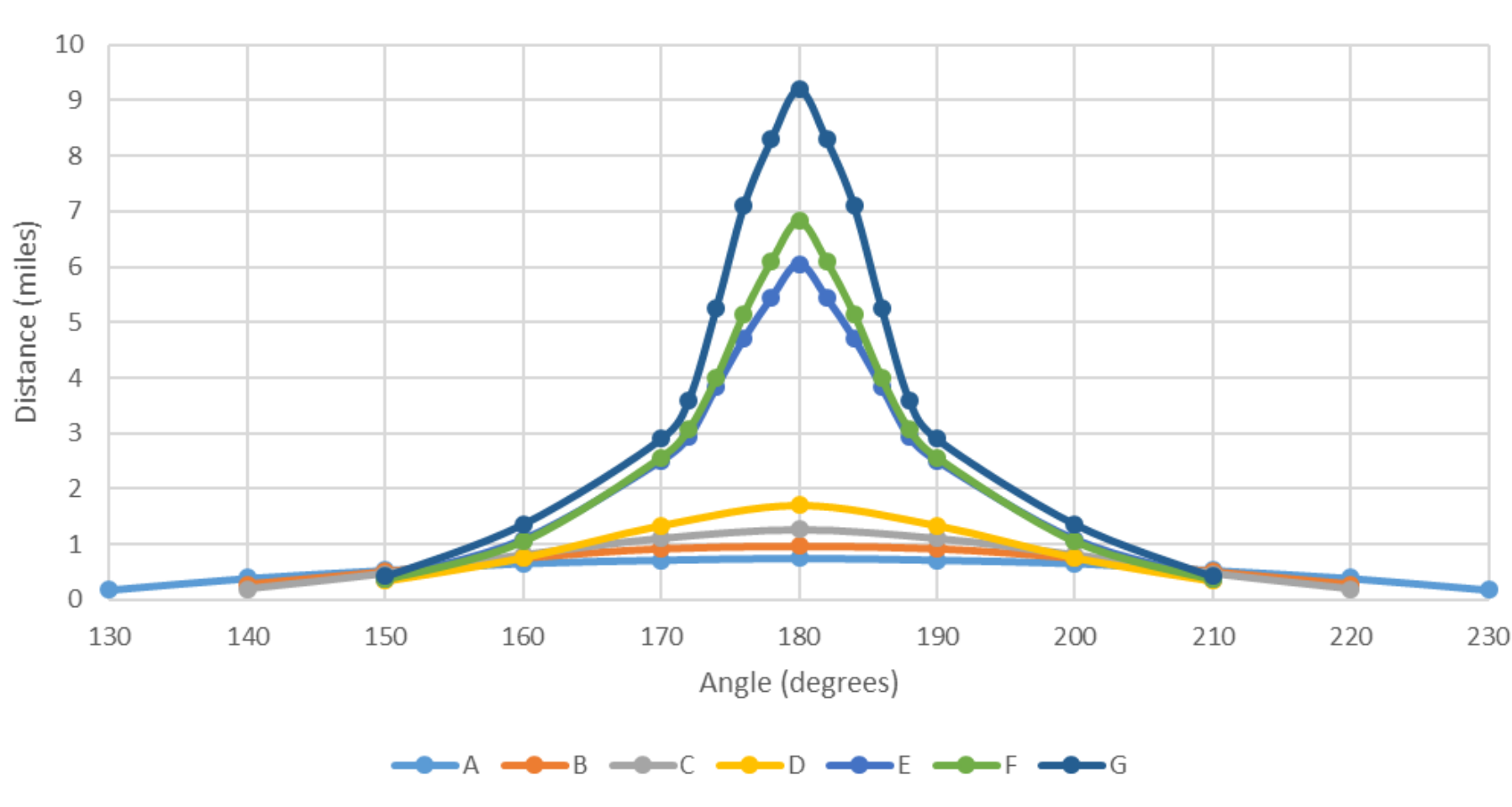
- 4 mph Wind Speed
- Stability Class D
- Winds to the South
- Variable Rain

1 rem Isodose Distance vs. Plume Angle  
Wind Speed Sensitivity Analysis



- Variable Wind Speed (m/s)
- Stability Class D
- Winds to the South
- No Rain

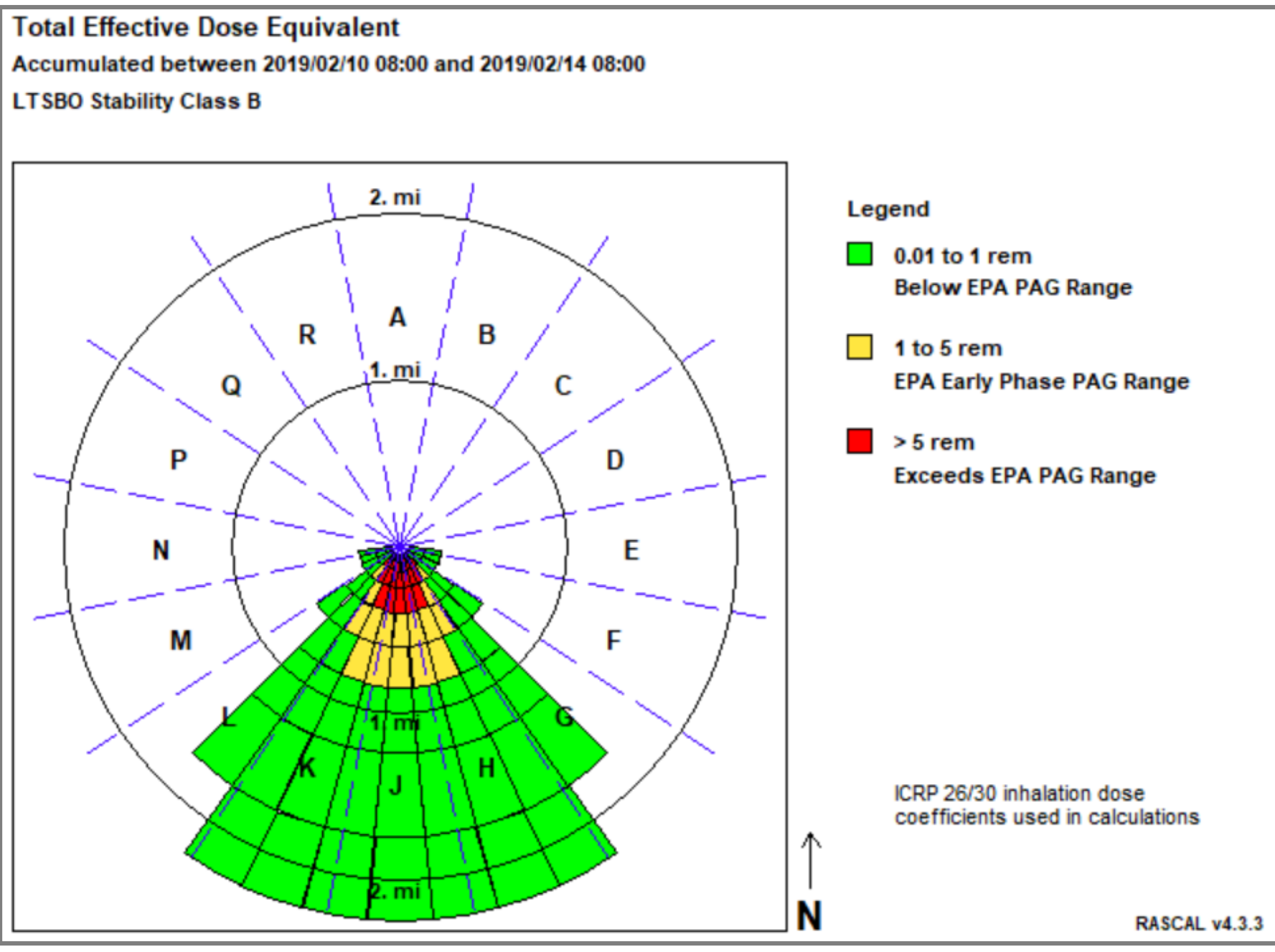
1 rem Isodose Distance vs. Plume Angle  
Stability Class Sensitivity Analysis



- 4 mph Winds
- Variable Stability Class
- Winds to the South
- No Rain

## How do conservative assumptions impact EPZ size determination?

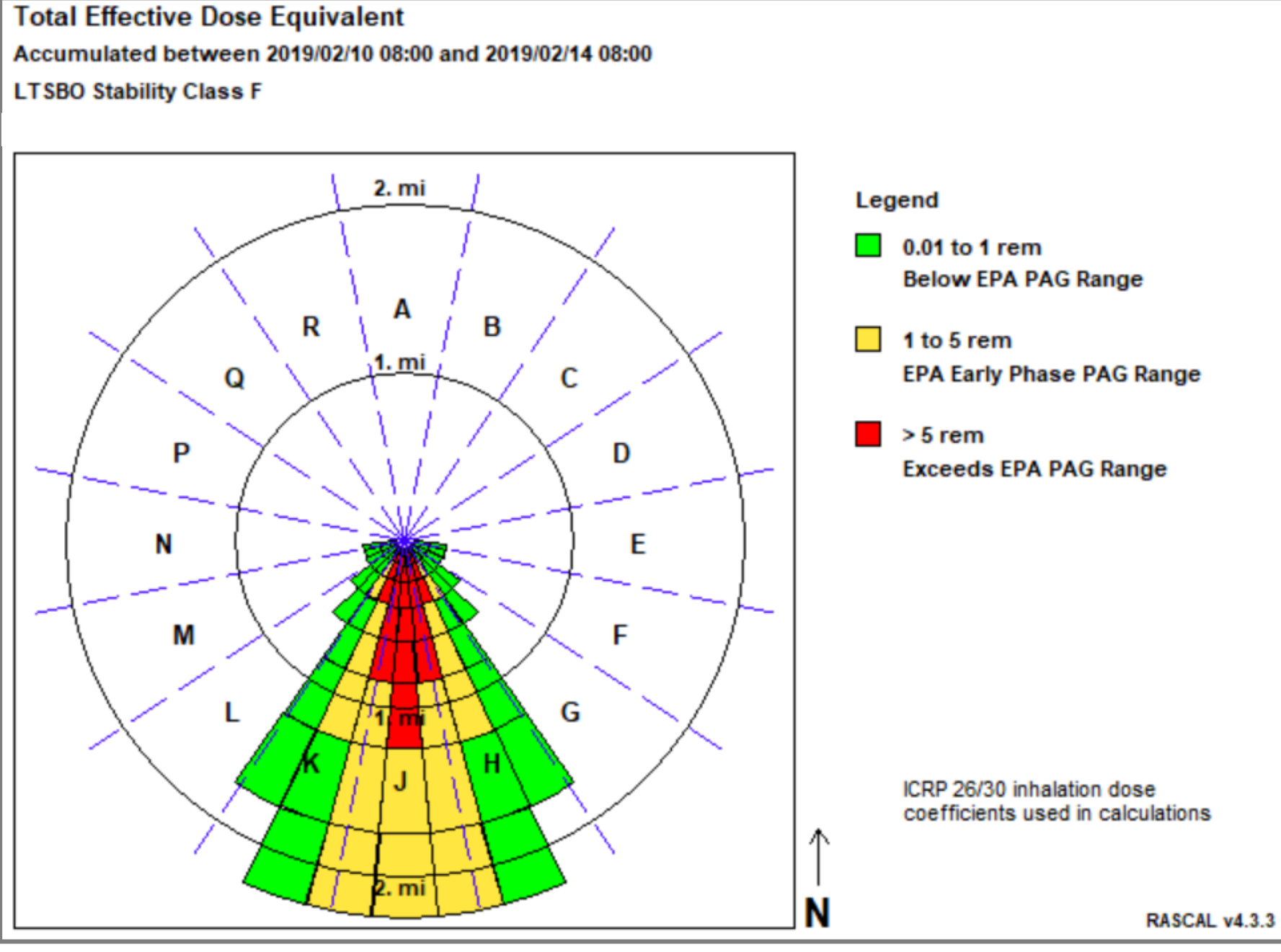
### Unstable Weather Plume Footprint



### Parameter Analysis Results

- Conservative modeling assumptions will drive EPZ size farther out.
- A higher dose farther out necessitates a larger EPZ.
- But do conservative and unrealistic assumptions provide meaningful results?

### Stable Weather Plume Footprint

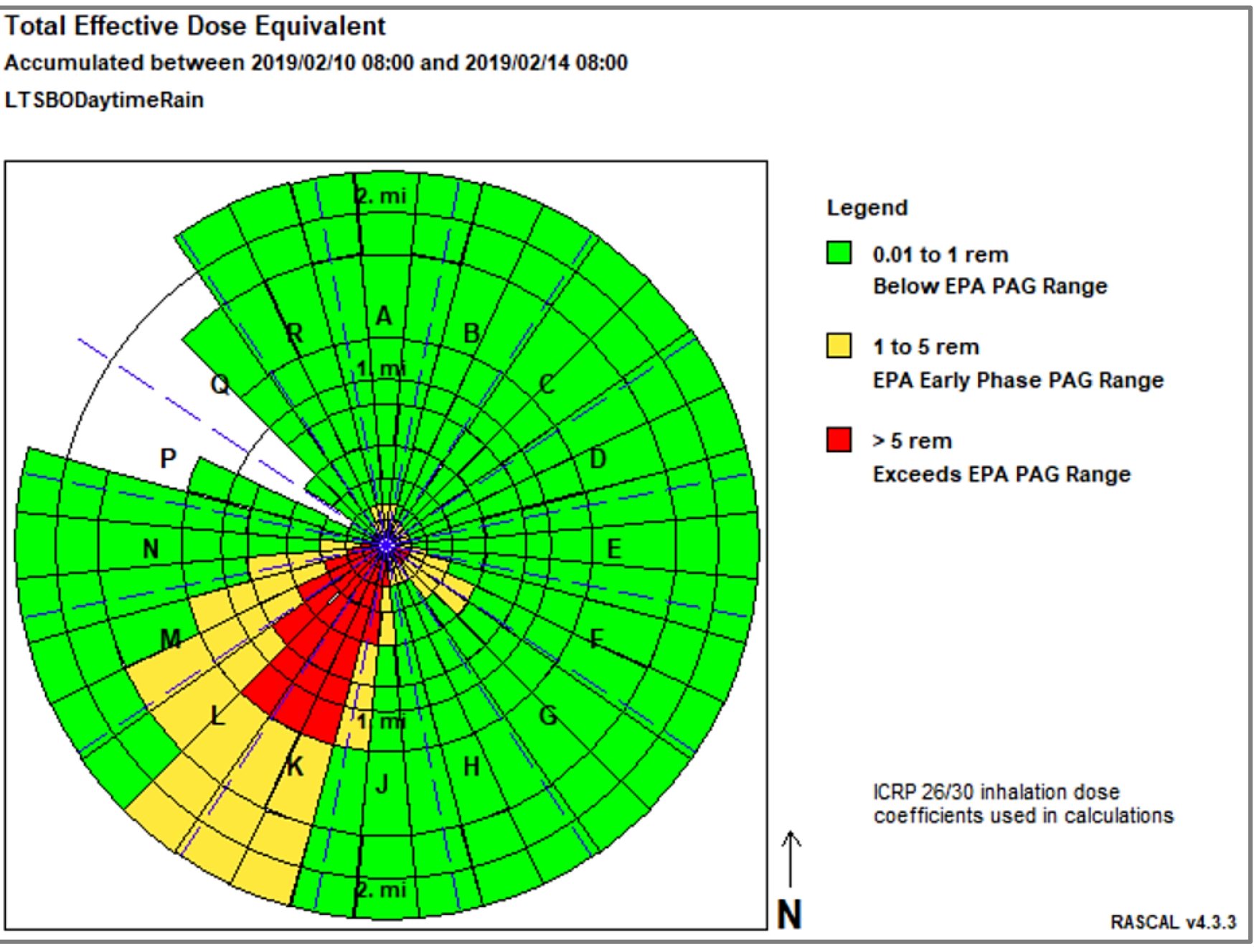


### Realistic Weather Scenario

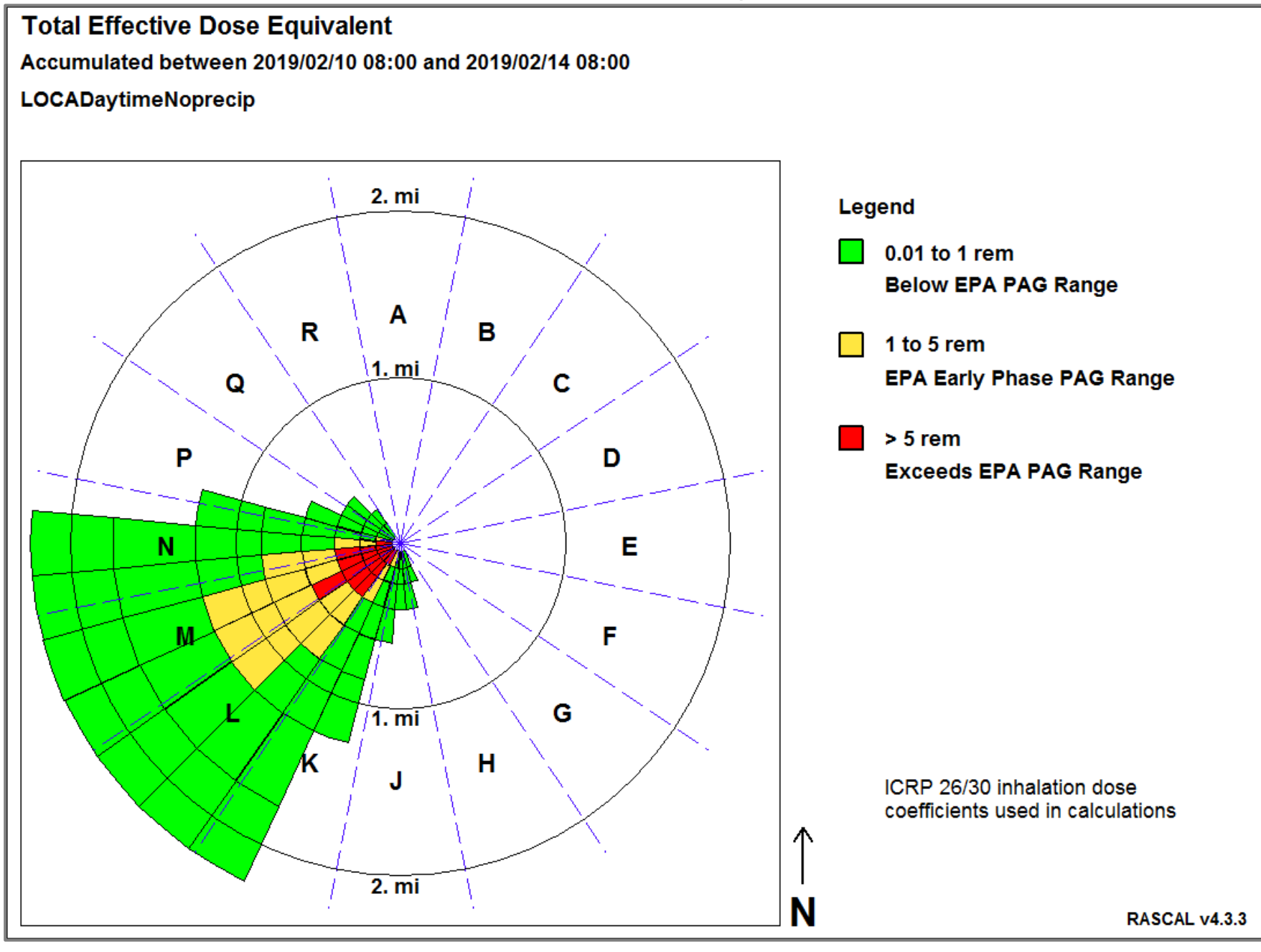
- Uses actual weather data from reference site.
- The wind variation is the same for the rain and no-rain conditions.
- Stability class was estimated from tabularized Pasquill Stability Class data.

## What is the importance of realistic weather and source term assumptions for EPZ size?

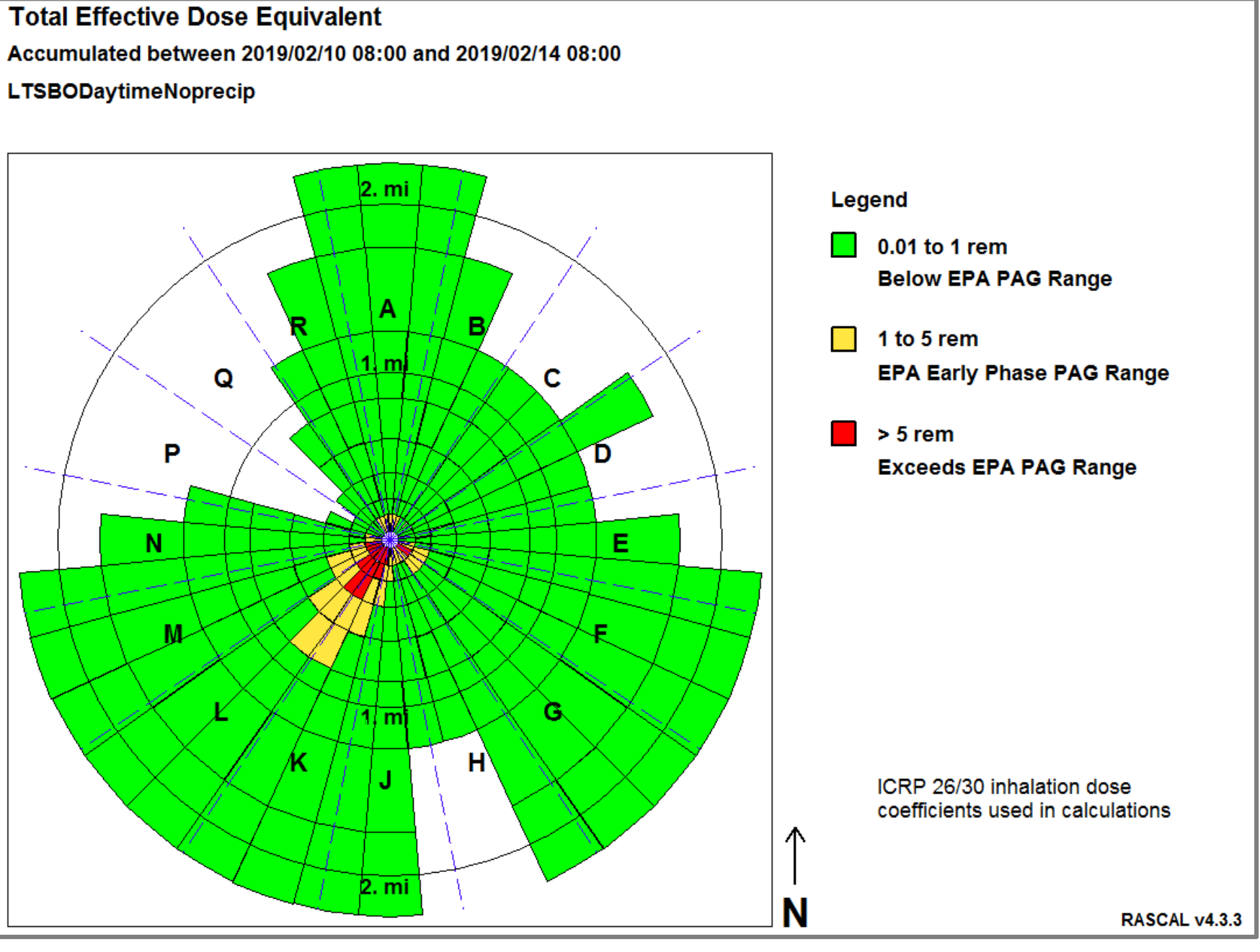
### LTSBO Realistic Weather with Rain



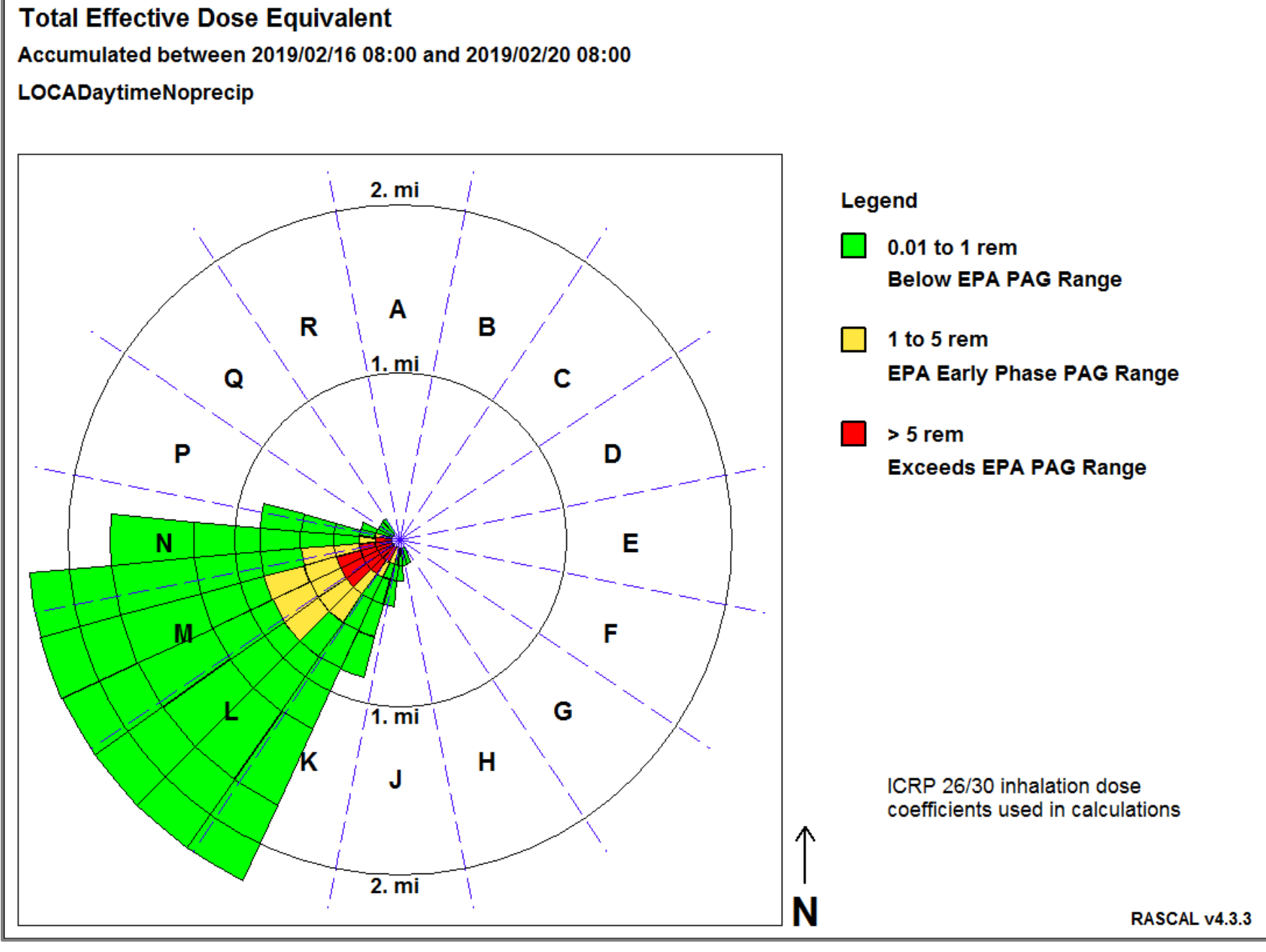
### LOCA Realistic Weather Early Release



### LTSBO Realistic Weather No Rain



### LOCA Realistic Weather Delayed (6 day) Release



## Conclusions

- EPZ size is sensitive to weather related phenomena. Wind speed and persistence, stability class, and precipitation are all important.
- Dispersion modeling is important: many factors vary significantly within a short distance, creating large variation in dose-at-distance.
- Release timing and release rate are important to the sensitivity analysis.

## Insights and Recommendations

- Realistic, site-specific weather patterns should be used for EPZ size determination analyses as opposed to simple, conservative assumptions.
- Designers of advanced reactors can minimize source term or delay potential releases to reduce emergency planning needs.
- The NRC may want to consider technology-neutral source term models for RASCAL to enhance emergency response capabilities.